What is claimed is:

1. A dunnage conversion machine for converting sheet material into a dunnage product, comprising:

a forming assembly for shaping the sheet material into a continuous strip of dunnage including a three-dimensional shape; and

a pulling assembly positioned downstream from the forming assembly for advancing the sheet material through the forming assembly;

the pulling assembly including at least two grippers movable together through a transfer region in opposition to one another and cooperative to grip therebetween the dunnage strip for advancing the dunnage strip through the transfer region, and at least one of the grippers including an aperture operative to gather and laterally capture therein the dunnage strip as the grippers move through the transfer region.

2. The dunnage conversion machine of claim 1, wherein the aperture tapers in width going from an outer to an inner end of the gripper.

3. The dunnage conversion machine of claim 1, wherein the aperture is V-shape.

4. The dunnage conversion machine of claim 3, wherein the V-shape aperture has a rounded bottom.

5. The dunnage conversion machine of claim 1, wherein the opposing grippers have contact regions operative to deform opposite sides of the strip of dunnage to capture the strip of dunnage between the opposing grippers.

6. The dunnage conversion machine of claim 1, wherein the grippers move through the transfer region in longitudinally offset yet paired relation for gripping and advancing the strip of dunnage.

7. The dunnage conversion machine of claim 1, wherein the opposing grippers transversely overlap while advancing the strip of dunnage.

8. The dunnage conversion machine of claim 1, wherein the grippers are arranged in transversely opposed sets of grippers disposed on opposite transverse sides of the transfer region.

9. The dunnage conversion machine of claim 8, wherein the grippers of the opposed sets progressively move towards one another at an upstream end of the transfer region and progressively move away from one another at a downstream end of the transfer region.

10. The dunnage conversion machine of claim 9, wherein the grippers of each set are circumferentially spaced around a common axis and are joined together for rotation about the common axis.

11. The dunnage conversion machine of claim 10, wherein the grippers of each set extend perpendicularly from the respective common axis.

12. The dunnage conversion machine of claim 9, wherein the pulling assembly further includes a set of transfer assemblies having connected thereto the respective sets of grippers, the transfer assemblies being operative to move the grippers of the respective set toward each other at the upstream end of the transfer region to transversely engage the strip of dunnage and away from each other at the downstream end of the transfer region to release the strip of dunnage.

13. The dunnage conversion machine of claim 12, wherein the grippers of each set are movable along a non-circular path in opposite relation to one another and are operative sequentially, as the grippers move along the non-circular path in opposite relation, to transversely engage the strip of dunnage therebetween on opposite sides thereof for advancing therewith the strip of dunnage.

14. The dunnage conversion machine of claim 13, wherein opposing grippers moving downstream of the non-circular path release the strip of dunnage substantially simultaneously with or after opposing grippers moving along the non-circular path, upstream of the non-circular path, transversely engage the strip of dunnage.

15. The dunnage conversion machine of claim 13, wherein opposing grippers moving downstream of the non-circular path release the strip of dunnage substantially simultaneously with or after opposing grippers moving along the non-circular path, upstream of the non-circular path, advance the strip of dunnage.

16. The dunnage conversion machine of claim 13, wherein each transfer assembly includes a flexible transfer element and a pair of wheels mounted on respective longitudinally

spaced axles, the flexible transfer element having portions thereof trained over the pair of wheels, and wherein the grippers of said respective opposing sets of grippers are affixed to and extend from said respective flexible transfer elements such that at least one gripper from each of said respective opposing sets of grippers are in operative engagement with the strip of dunnage when moving along the non-circular path.

17. The dunnage conversion machine of claim 16, wherein the grippers of each set extend perpendicularly from the respective flexible transfer element.

18. The dunnage conversion machine of claim 16, wherein, upon rotation of the pair of wheels, the at least one gripper from each of said respective opposing sets of grippers is longitudinally offset to provide clearance therebetween upon convergence thereof.

19. The dunnage conversion machine of claim 16, wherein the flexible transfer elements of the transfer assemblies comprise articulating chains.

20. The dunnage conversion machine of claim 16, wherein the flexible transfer elements of the transfer assemblies comprise flexible belts.

21. The dunnage conversion machine of claim 16, wherein movement of the flexible transfer elements is synchronized.

22. The dunnage conversion machine of claim 1, wherein the forming assembly includes a constriction member through which the sheet material is pulled to effect crumpling thereof and forming of the strip of dunnage.

23. The dunnage conversion machine of claim 22, wherein the constriction member is a ring.

24. The dunnage conversion machine of claim 22, wherein the ring is oval and has rounded edges at the upstream end thereof.

25. The dunnage conversion machine of claim 1, wherein the forming assembly includes a constriction member at an upstream end thereof which constricts and guides the strip of dunnage from a downstream end of the forming assembly to an engagement region between the opposing grippers.

26. The dunnage conversion machine of claim 25, wherein the constriction member defines an oval aperture through which the strip of dunnage is compressed circumferentially, the width of the aperture being smaller than the width of the sheet material.

27. The dunnage conversion machine of claim 1, wherein

the grippers are arranged in transversely opposed first and second sets of grippers connected to respective first and second gripper carriages disposed on opposite transverse sides of the transfer region;

the first gripper carriage being operative to move longitudinally the first set of grippers along a first non-circular path and the second gripper carriage being operative to move longitudinally the second set of grippers in synchronous relation to the first set of grippers along a second non-circular path, wherein portions of the first and second paths are juxtaposed to define therebetween the transfer region and wherein at least one gripper of the first set of grippers and at least one gripper of the second set of grippers are operative to transversely engage the strip of dunnage on opposite sides thereof for advancing the strip of dunnage through the transfer region.

28. The dunnage conversion machine of claim 27, wherein the transfer region comprises an engagement region whereat the first and second non-circular paths converge toward one another, an advancement region whereat the first and second non-circular paths are substantially parallel to one another, and a release region whereat the first and second non-circular paths diverge away from one another.

29. The dunnage conversion machine of claim 1, wherein

the pulling assembly includes first and second transfer elements and first and second series of wheels, wherein the first and second transfer elements are trained over the respective first and second series of wheels and include one or more grippers extending therefrom, the first and second series of wheels rotate in opposite directions and the first and second transfer elements are opposed to define the transfer region therebetween, whereby the grippers of the respective first and second transfer elements are progressively brought into opposing relation to engage and transfer the strip of dunnage through the transfer region.

30. The dunnage conversion machine of claim 29, wherein, as the first and second series of wheels rotate, the grippers of the respective first and second transfer elements converge toward one another at an upstream end of the dunnage transferring mechanism to engage opposite sides of the strip of dunnage, transfer the strip of dunnage through the

transfer region, and then diverge away from one another at a downstream end of the dunnage transferring mechanism to release the strip of dunnage.

31. A method of converting sheet material into a dunnage product, comprising the steps of:

using a forming assembly for shaping the sheet material into a continuous strip of dunnage including a three-dimensional shape; and

using a pulling assembly positioned downstream from the forming assembly for advancing the sheet material through the forming assembly;

wherein the step of advancing the sheet material includes moving grippers together through a transfer region in opposition to one another to cooperatively grip therebetween the dunnage strip and advance the dunnage strip through the transfer region, while an aperture in at least one of the grippers gathers and laterally captures therein the dunnage strip as the grippers are moved through the transfer region.

32. The method as set forth in claim 31, wherein the step of capturing the strip of dunnage between the opposing grippers includes deforming opposite sides of the strip of dunnage.

33. The method as set forth in claim 31, wherein the step of moving the grippers together includes moving the grippers through the transfer region in longitudinally offset yet paired relation for gripping and advancing the strip of dunnage.

34. The method as set forth in claim 31, wherein the opposing grippers transversely overlap while advancing the strip of dunnage.

35. The method as set forth in claim 31, wherein the grippers are arranged in transversely opposed sets of grippers disposed on opposite transverse sides of the transfer region, and the step of moving the grippers includes progressively moving the grippers towards one another at an upstream end of the transfer region and progressively moving the grippers away from one another at a downstream end of the transfer region.

36. The method as set forth in claim 31, wherein the pulling assembly further includes a set of transfer assemblies having connected thereto the respective sets of grippers, and the step of moving the grippers includes moving the using the transfer assemblies to move the grippers toward each other at the upstream end of the transfer region to transversely

engage the strip of dunnage and away from each other at the downstream end of the transfer region to release the strip of dunnage.

37. The method as set forth in claim 36, wherein the step of moving the grippers includes moving the grippers along a non-circular path in opposite relation to one another and, as the grippers move along the non-circular path in opposing relation, sequentially transversely engaging the strip of dunnage therebetween on opposite sides thereof for advancing therewith the strip of dunnage.

38. The method as set forth in claim 37, wherein opposing grippers moving downstream of the non-circular path release the strip of dunnage substantially simultaneously with or after opposing grippers moving along the non-circular path, upstream of the non-circular path, transversely engage the strip of dunnage.

39. The method as set forth in claim 37, wherein opposing grippers moving downstream of the non-circular path release the strip of dunnage substantially simultaneously with or after opposing grippers moving along the non-circular path, upstream of the non-circular path, advance the strip of dunnage.

40. The method as set forth in claim 36, wherein movement of the flexible transfer assemblies is synchronized.

41. The method as set forth in claim 31, wherein the step of using the forming assembly includes guiding the strip of dunnage through a constriction member at an upstream end of the forming assembly thereby guiding the strip of dunnage from a downstream end of the forming assembly to an engagement region between the opposing sets of grippers.

42. The method as set forth in claim 31, wherein the grippers are arranged in transversely opposed first and second sets of grippers connected to respective first and second gripper carriages disposed on opposite transverse sides of the transfer region; and

wherein the step of advancing the sheet material includes moving longitudinally the first set of grippers along a first non-circular path and moving longitudinally the second set of grippers in synchronous relation to the movement in the first set of grippers along a second non-circular path; and

wherein portions of the first and second paths are juxtaposed to define therebetween the transfer region and wherein the step of advancing the sheet material further includes transversely engaging the strip of dunnage on opposite sides thereof between at least one

gripper of the first set of grippers and at least one gripper of the second set of grippers for advancing the strip of dunnage through the transfer region.

43. The method as set forth in claim 42, wherein the transfer region comprises an engagement region whereat the first and second non-circular paths converge toward one another, an advancement region whereat the first and second non-circular paths are substantially parallel to one another, and a release region whereat the first and second non-circular paths diverge away from one another.

44. A severing assembly for a dunnage conversion machine for converting sheet material, such as paper having at least one ply, into a severed section of dunnage, the machine including conversion assemblies for converting the sheet material into a continuous strip of dunnage, the severing assembly being positioned relative to the conversion assemblies to sever the continuous strip of dunnage into a severed section of a desired length, the severing assembly comprising:

a movable blade; and

a reciprocating actuator connected to the movable blade by a motion transmitting assembly that moves the movable blade from a ready-to-sever position to a severed position and back to a ready-to-sever position upon a single stroke of the reciprocating actuator in either direction.

45. A severing assembly as set forth in claim 44, wherein the severing assembly further includes a stationary blade which coacts with the movable blade as the movable blade moves to the severed position.

46. A severing assembly as set forth in claim 44, wherein the movable blade coacts with the stationary blade in a scissor fashion.

47. A dunnage conversion machine for converting sheet material, such as paper having at least one ply, into a severed section of dunnage, the machine comprising:

conversion assemblies for converting the sheet material into a continuous strip of dunnage; and

a severing assembly positioned relative to the conversion assemblies to sever the continuous strip of dunnage into a severed section of a desired length, the severing assembly comprising:

a movable blade; and

a reciprocating actuator connected to the movable blade by a motion transmitting assembly that moves the movable blade from a ready-to-sever position to a severed position and back to a ready-to-sever position upon a single stroke of the reciprocating actuator in either direction.

48. A dunnage conversion machine as set forth in claim 47, further including an end plate having an upstream side and a downstream side, the conversion assemblies being positioned upstream of the end plate, the end plate having a dunnage outlet opening through which the strip of dunnage emerges, the severing assembly being operative to sever the continuous strip of dunnage after a length of the strip of dunnage has passed through the outlet opening.

49. A dunnage conversion machine as set forth in claim 48, wherein the movable blade is mounted to the downstream side of the end plate and coupled to the motion-transmitting assembly, the movable blade being movable in a plane parallel to the plane defined by the outlet opening and across the outlet opening as it travels between the ready-to-sever position and the severed position.

50. A dunnage conversion machine as set forth in claim 48, wherein the motion-transmitting assembly comprises at least one linkage member pivotally coupled to the movable blade.

51. A dunnage conversion machine as set forth in claim 50, wherein guide plates are mounted on the end plate adjacent the outlet opening and wherein the movable blade is slidably retained within the guide plates whereby, as the reciprocating actuator is moved either in a single forward stroke or a single return stroke, the position of the linkage member will be varied to pivot the movable blade from the ready-to-sever position to the severed position and back to the ready-to-sever position.

52. A dunnage conversion machine as set forth in claim 50, wherein one end of the movable blade is pivotally mounted to the end plate at a pivot point, whereby as the reciprocating actuator is moved either in a single forward stroke or a single return stroke, the position of the linkage member will be varied to pivot the movable blade from the ready-to-sever position to the severed position and back to the ready-to-sever position.

53. A dunnage conversion machine as set forth in claim 48, wherein the severing assembly includes a flared guide member mounted to the upstream side of the end plate for guiding the continuous strip of dunnage into the dunnage outlet opening.

54. A dunnage conversion machine as set forth in claim 47, wherein the conversion assemblies include:

a forming assembly which shapes the sheet material into the continuous strip of dunnage;

a stock supply assembly which supplies the sheet material to the forming assembly; and

a pulling assembly which pulls the sheet material from the stock supply assembly and through the forming assembly to form the strip of dunnage.

55. A method of severing a continuous strip of dunnage into a severed section of a desired length, comprising the steps of:

using conversion assemblies for converting sheet material, such as paper having at least one ply, into a continuous strip of dunnage, and

using a severing assembly positioned relative to the conversion assemblies to sever the continuous strip of dunnage into a severed section of a desired length, wherein the severing assembly includes a movable blade and a reciprocating actuator connected to the movable blade by a motion transmitting assembly;

wherein using the severing assembly includes moving the reciprocating actuator a single stroke, whereby the motion transmitting assembly moves the movable blade from a ready-to-sever position to a severed position and back to the ready-to-sever position.

56. A method as set forth in claim 55, wherein the step of moving the reciprocating actuator includes extending the reciprocating actuator in a forward stroke whereby the movable blade is moved from the ready-to-sever position, to the severed position and back to the ready-to-sever position.

57. A method as set forth in claim 55, wherein the step of moving the reciprocating actuator includes retracting the reciprocating actuator in a return stroke whereby the movable blade is moved from the ready-to-sever position, to the severed position and back to the ready-to-sever position.

58. A void fill dunnage product comprising: a three dimensional crumpled strip round in cross-section and including at least one ply of sheet material having, in cross-section, a crumpled multi-lobed undulating body, with the lobes thereof extending longitudinally and being dispersed in an irregular pattern.

59. A dunnage product as set forth in claim 58, further including at least one transverse crimp on opposite transverse sides of the strip of dunnage, which crimps are longitudinally offset from one another.

60. A dunnage product as set forth in claim 58, wherein one or more cross-sections of spaced portions of the strip of dunnage are deformed.

61. A method of producing a dunnage product, the method comprising the steps of:

supplying a sheet material having at least one ply;

causing inward folding of the lateral edges of the at least one ply of sheet material whereby a three dimensional crumpled strip of dunnage of generally round cross-sectional shape is formed, with at least one ply of sheet material forming, in cross-section, a crumpled multi-lobed undulating body, the lobes thereof extending longitudinally and being dispersed in an irregular pattern.

62. A method as set forth in claim 61, further including the step of regularly transversely crimping the strip of dunnage on opposite sides thereof, the crimping on one side being longitudinally offset from the crimping on the opposite side thereof.

63. A method as set forth in claim 61, wherein the step of causing inward folding includes using a pulling assembly for pulling the strip of dunnage through a constriction member to both narrow the strip of dunnage via three dimensional crumpling thereof and to guide the strip of dunnage to the pulling assembly.

64. A method as set forth in claim 61, further including the step of deforming one or more cross-sections of spaced portions of the strip of dunnage.